Vegetable Transplant Production and Management

Plants of high quality and vigor may be produced in a greenhouse for season long crop plantings. This allows the producer to set healthy growing plants to the field for early production, better weed control and/or more effective use of the land.

Vigorous, healthy transplants grow and mature quickly, enabling the producer to market a quality crop earlier, often at higher market prices. Poor transplants may not respond, even to the best conditions in the field. Each crop varies in its response to transplant shock and environmental conditions during field growth.

Plant Growing Structures

Polyethylene Greenhouses

The most economical and easily constructed growing structures are polyethylene greenhouses. Adequate attention should be given to heating and ventilation systems which can either be manually or automatically operated. Only crops requiring similar growing conditions should be grown in the same greenhouse.

Hot Beds and Cold Frames

Growers for many years have used structures known as hot beds and cold frames. These are of similar construction to greenhouses. Hot beds are heated with manure, hot air, hot water, steam or electricity, while the cold frames are unheated.

Cold frames are used mainly to harden plants grown in the heated structures, but the labor required is greater, and the temperature is more difficult to control, than in equipped plastic greenhouses.

Seeds

Only top quality seed of recommended cultivars from a reputable seed company should be used. Seeds treated to control diseases and insects are recommended.

Some companies provide precision sized seeds of high germination percentage and seedling vigor, for use in module trays or peat blocks. Sometimes these seeds can be coated for use with automatic seeders.

Growing Media

A growing media has three major portions - air, solids and water. The air space is needed to provide oxygen for wet respiration, to allow nutrification, and some microbial activity. The air space in a mix complements the water portion, since air replaces the water absorbed by the plant roots. The air/water

ratio in a mix is determined by the panicle size of the solids. A coarse mix has relatively more air and less water-filled pore space than a fine mix.

After watering, several of the soilless mixes will have 75% of the total space filled by water with the remainder taken up by solids and air. In a soil mix, solids compose 50% of the space with the balance divided between air and water. This basic difference between a soil and soilless mix therefore necessitates different crop management.

Preparing a Growing Media

There are several considerations:

1. Water-holding capacity
2. air porosity
3. nutrient availability
4. buffering capacity
5. weight
6. price.

A mix should perform four basic functions for plants:

1. Provide an anchor system for the plant roots.
2. Store water for plant-root absorption.
3. Provide nutrients in the water solution that can be absorbed by the roots.
4. Provide oxygen (air spaces) for root respiration.
   Taken from Soilless Mixes, OMAF Agdex 296/510

Commercial Prepared Mixes

Commercially prepared soilless mixes are available with the pH adjusted; trace elements added and usually contain a small amount of fertilizer. A ready-made mix is often the most economical especially when comparing the cost of labor to preparing a mix. There is a wide selection of prepared mixes available with different peat ratios and fertilizer formulations. The prepared mixes are generally consistent but a soil sample should be taken so the grower knows the initial pH and total salts.

Preparing a Soil or Soilless Mix

Soil mixes are generally a 1-2-1 formulation with 25-30% soil, 50% peat moss and 25-30% an aggregate such as vermiculite, perlite or sand. Soilless mixes are 50-100% peat moss with perlite, vermiculite, polystyrene chips or sand being added for aeration.

Soil

A field soil to be used in a growing media should be friable, uniform, well-aerated yet capable of holding moisture with a pH of 6.0 - 6.5. The field should be free of potentially toxic chemicals such as herbicides and high total soluble salts.

Soil Pasteurization

Soil used in a growing media should be pasteurized. Soil is pasteurized to reduce harmful soil diseases such as damping off and clubroot, bacteria, weed seeds and nematodes. Most harmful organisms can be eliminated in the soil by maintaining a temperature of 60° C for 20 minutes throughout the root zone. This can be accomplished with steam or an electric soil pasteurizer. Chemical fumigants can be used to eliminate soil-borne insects, diseases, nematodes and weeds.

Peat Moss

Peat moss is the remains of dead plant material that builds up in layers in a peat bog. Sphagnum peat moss is the most desirable for a growing medium. Peat moss has a high cation exchange capacity which makes peat moss suitable for a nutrient reserve and a buffering agent. Peat moss in the natural state contains very few nutrients and has a low pH (3.5 - 4.5), and is considered free of active pathogenic diseases.

Coarse Aggregate

Vermiculite

Vermiculite is a micro mineral which has been expanded by heating at 900° C. It has a plate like structure which enables it to retain both water and fertilizer. The pH of vermiculite is near neutral and it contains significant quantities of available potassium and magnesium.

Perlite

Perlite is a silicaceous volcanic rock which when crushed and heated to about 1000° C expands like popcorn. It has a low cation exchange capacity and a pH of 7.0. It is inert and primarily added to the mix to improve aeration.

Sand

Sand is often added to a mix to provide weight. A sharp sand should be used as the rounded sand often plugs up drainage space reducing air space.

Polystryene Chips

Polystryene chips are a by-product of polystryene bead boards. The material is near pH 7.0 and has a low cation exchange capacity and is inert. It is added to provide aeration.

Soil Mix

Top soil or compost	.25 cubic meter
sphagnum peat moss	.50 cubic meter

aggregate: vermiculite, perlite or sand	.25 cubic meter
superphosphate (0·20·0)	3 kg
ground limestone	5 kg
	1.0 cubic meter

Soilless Mix

sphagnum peat moss	.50 cubic meter
aggregate: vermiculite, perlite	.50 cubic meter
or sand	
limestone	3 to 5 kg
superphosphate (0·20-0)	1 to 5 kg
trace elements (FTE 302)	75 g
or trace elements (FTE 555)	110 g
calcium or potassium nitrate	500 g
magnesium sulfate (Mg SO_4)	300 g
wetting agent	100 mL
Borax (11%)	20 mL
Iron Chelate 138	35 mL
	1.0 cubic meter

Fertility

Use one of the following programs:

1. Complete soluble fertilizers may be added while watering the plants. The approximate rate is 9 g per square meter, or as directed, and this may be repeated as required or approximately every 10 days. Formulations containing trace elements are prepared especially for greenhouse growing and are available as soluble 15-30-15, 20-20-20. Use a fertilizer low in ammonia nitrogen such as the formulations designed for soilless mixes such as 15-15-18 or peat-lite special.
2. These soluble fertilizers mixed dry will supply adequate nutrition for 5 weeks:
   Soluble 15·30·15 or 20-20.20 1.5 kg per cubic meter
3. This fertilizer combination mixed dry will supply adequate nutrition for up to 5 weeks:
   Potassium nitrate (14-0-44) 0.5 kg per cubic meter
   Superphosphate (20%) 0.1 kg per cubic meter

Cautions

1. Reduce rates for seedling flats by 1/3 to 1/2.
2. Commercial field fertilizer mixtures such as 6-12-12 should not be used unless the amount of ingredients in the mix are known. High analysis mixtures (15-30-15, 12-24-24) should be avoided

because of high ammonium release.

3. To avoid possible trace elements or minor element deficiency, include when mixing:
   FTE (fritted trace element) 50 mL per cubic meter
4. Wetting Agents: a nonionic surfactant such as Aquagrow may be used to speed wetting - 100 mL per cubic meter. Agrol 90 may also be used.

Specialty Crop Germination Benches

In order to maintain germination temperatures, a thermostatically controlled heated bench is recommended. Flats can be covered with white plastic to conserve moisture and speed germination. Flats should be inspected twice a day at the time of germination. Remove cover as soon as plants are through the soil.

Growing Conditions

Proper conditions of temperature, moisture and light are necessary for the production of quality transplants.

(a) Light - Care should be taken to locate and construct the greenhouse so that plants receive the maximum amount of sunlight

(b) Temperature -A slightly higher temperature is required during daylight periods than at night or in periods of low light. Newly planted seed flats require a higher temperature and constant moisture to promote germination. When temperatures are maintained at too high a level after germination the plants become “leggy", "soft" and susceptible to diseases. Low temperatures result in stunted plants. Growing temperatures below 10° C for lengthy periods may cause bolting (formation of seed stalks) in cole crops and celery.

(c) Moisture - Plants require adequate water for normal growth. Overwatering causes succulent plants that are more susceptible to damping-off. Under watering results in slow, stunted growth.

Transplant Growing Schedule

Crop	Time in Greenhouse (Weeks)	Germination Temp (C)	Growing Temp (C)	Space in Flats (Cubic cm)	Plants/Square meter	Plants/Grams of Seed	Seed For 1 ha
Cauliflower	6-7	21	16	16-32	300-600	200	300 g
Cabbage	5-7	21	10-16	16-32	300-600	200	300 g
Celery	10-12	21-24	16-18	13-25	400-750	500	150 g
Lettuce	6-8	21	10-16	13-25	400-750	350	250 g
Cucumber	2-4	24	18-24	100	100	20	3 Kg

Onion	10	16-18	16	3	3000	150	1 Kg
Pepper	9-10	21-24	16-18	25-40	250-400	50	550 g
Tomato	5-8	21	16-18	40-50	200-250	150	300 g
Squash	2-4	24	18-20	100	100	7	5 Kg

Hardening Crop

Transplants should not be over-hardened because of the danger of permanent stunting. Cabbage, cauliflower and onions may be hardened by reducing the temperature to between 10 and 12°C, or in the case of lettuce, to 9 10°C, while at the same time reducing watering. Squash, cucumbers and melons should be hardened only by reducing moisture. In the 2 weeks prior to transplanting it is advisable not to supplement nitrogen in the medium. Reduction of N, as with moisture, serves to prepare the plant for transplanting by toughening it up. A boost of N can be supplied at, or just immediately prior to transplanting.

Containers for Plant Growing

Many growers are using flats with individual cells (modules) to produce transplants. This type of flat has the following advantages:

1. ease of handling
2. little or no transplanting shock
3. mechanization of seeding and field transplanting

The use of modules require proper watering as the small amount of soil mix in each cell leads to faster drying of the soil. These plants are also more prone to nutrient deficiencies. Therefore, more frequent watering and feeding is required. The initial capital cost of equipment and seeding trays along with maintenance costs do add to plant production costs. There are two main types: a rectangular cell and an inverted pyramid, shaped cell, such as a seedling tray.

Greenhouse Cleanup

After vegetables transplants have been removed from the greenhouse (and empty), it should be disinfected to prevent organisms from carrying over. Spray the inside structure with either:

1) Sodium hypochlorite 5-6% - 1 part to 9 parts water
2) Formaldehyde - 1 part to 40 parts water

The greenhouse should be closed for 3-4 days and then ventilated. These solutions can also be used to disinfect benches, flats, water spouts, seedling trays, etc. Always wear suitable respirators and protective clothing when applying the above chemicals.

Seeds

Approximate Number per Gram

Crop	Seeds per Gram
Asparagus	50
Bean, snap	2-3
Beet, Swiss Chard	50
Broccoli	320
Brussel Sprouts	280
Cabbage	300
Chinese Cabbage	250
Cauliflower	350
Celery, Celeriac	1800
Chicory	600
Corn	4-8
Cucumber	40
Egg Plant	200
Endive	550
Kale	270
Kohlrabi	280
Leek	350
Lettuce	700
Melon	400
Onion	280
Parsley	550
Parsnip	200

Pepper	150
Pumpkin	4
Radish	125
Rutabaga	280
Spinach	90
Squash	10
Tomato	350
Watermelon	10

Bibliography

This document was originally part of the Vegetable Production in Atlantic Canada Guide Produced by the APASCC Advisory Committee on Vegatable Production, it was reformatted and updated by Perennia in 2017.

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